STRATEGY FOR RECOVERY

A core area represents the closest approximation of a biologically functioning unit for bull trout. The combination of core habitat (*i.e.*, habitat that could supply all the necessary elements for the long-term security of bull trout, including for both spawning and rearing, as well as for foraging, migrating, and overwintering) and a core population (*i.e.*, bull trout inhabiting a core habitat) constitutes the basic core area upon which to gauge recovery within a recovery unit. Within a core area, many local populations may exist.

It is likely that historic distribution of bull trout was more expansive than currently observed. Current distribution of bull trout in the Lower Columbia Recovery Unit is fragmented and bull trout exist in two core areas (Lewis and Klickitat). The White Salmon River is considered core habitat and reestablishment of bull trout in the watershed is considered necessary for recovery. Migratory life-history strategies of bull trout probably used the mainstem Columbia River for feeding and overwintering. The extent and timing of use of the mainstem Columbia River by bull trout is a research need and considered as potential core habitat important for recovery of fluvial bull trout in the recovery. Isolation and fragmentation of bull trout by dams and poor habitat conditions were identified as limiting factors in the Lower Columbia Recovery Unit. Removal of these threats, and reestablishing connectivity within the basin has been deemed essential for recovery.

Recovery Goals and Objectives

The goal of the bull trout recovery plan is to **ensure the long-term persistence of self-sustaining, complex, interacting groups of bull trout distributed throughout the species' native range, so that the species can be delisted.** To achieve this goal the following objectives have been identified for bull trout in the Lower Columbia Recovery Unit.

- **Maintain current distribution of bull trout and restore distribution in previously occupied areas within the Lower Columbia Recovery Unit.**
- **Maintain stable or increasing trends in abundance of bull trout.**

- **Restore and maintain suitable habitat conditions for all bull trout life history stages and strategies.**

- **Conserve genetic diversity and provide opportunity for genetic exchange.**

Rieman and McIntyre (1993) and Rieman and Allendorf (2001) evaluated the bull trout population numbers and habitat thresholds necessary for long-term viability of the species. They identified four elements, and the characteristics of those elements, to consider when evaluating the viability of bull trout populations. These four elements are 1) number of local populations; 2) adult abundance (defined as the number of spawning fish present in a core area in a given year); 3) productivity, or the reproductive rate of the population (as measured by population trend and variability); and 4) connectivity (as represented by the migratory life history form and functional habitat). For each element, the Lower Columbia Recovery Unit Team classified bull trout into relative risk categories based on the best available data and the professional judgment of the team.

The Lower Columbia Recovery Unit Team also evaluated each element under a potential recovered condition to produce recovery criteria. Evaluation of these elements under a recovered condition assumed that actions identified within this chapter had been implemented. Recovery criteria for the Lower Columbia Recovery Unit reflect 1) the stated objectives for the recovery unit, 2) evaluation of each population element in both current and recovered conditions, and 3) consideration of current and recovered habitat characteristics within the recovery unit. Recovery criteria will probably be revised in the future as more detailed information on bull trout population dynamics becomes available. Given the limited information on bull trout, both the level of adult abundance and the number of local populations needed to lessen the risk of extinction should be viewed as a best estimate.

This approach to developing recovery criteria acknowledges that the status of populations in some core areas may remain short of ideals described by conservation biology theory. Some core areas may be limited by natural attributes or by patch size and may always remain at a relatively high risk of extinction. Because of limited data

within the Lower Columbia Recovery Unit, the recovery unit team relied heavily on the professional judgment of its members.

Local Populations

Metapopulation theory is important to consider in bull trout recovery. A metapopulation is an interacting network of local populations with varying frequencies of migration and gene flow among them (Meffe and Carroll 1994) (see Chapter 1). Multiple local populations distributed and interconnected throughout a watershed provide a mechanism for spreading risk from stochastic events. In part, distribution of local populations in such a manner is an indicator of a functioning core area. Based in part on guidance from Rieman and McIntyre (1993), bull trout core areas with fewer than 5 local populations are at increased risk, core areas with between 5 and 10 local populations are at intermediate risk, and core areas with more than 10 interconnected local populations are at diminished risk. Currently, only three local populations have been identified in the Lower Columbia Recovery Unit, and bull trout are considered to be at a increased risk. Additional local populations are needed to reduce the risk from deterministic or stochastic events which may threaten bull trout.

Abundance

The recovered abundance levels in the Lower Columbia Recovery Unit were determined by considering theoretical estimates of effective population size, historical census information, and the professional judgment of recovery team members. In general, effective population size is a theoretical concept that allows us to predict potential future losses of genetic variation within a population due to small population sizes and genetic drift (see Chapter 1). For the purpose of recovery planning, effective population size is the number of adult bull trout that successfully spawn annually. Based on standardized theoretical equations (Crow and Kimura 1970), guidelines have been established for maintaining minimum effective population sizes for conservation purposes. Effective population sizes of greater than 50 adults are necessary to prevent inbreeding depression and a potential decrease in viability or reproductive fitness of a population (Franklin 1980). To minimize the

loss of genetic variation due to genetic drift and to maintain constant genetic variance within a population, an effective population size of at least 500 is recommended (Franklin 1980; Soule 1980; Lande 1988). Effective population sizes required to maintain long-term genetic variation that can serve as a reservoir for future adaptations in response to natural selection and changing environmental conditions are discussed in Chapter 1 of the recovery plan.

For bull trout, Rieman and Allendorf (2001) estimated that a minimum number of 50 to 100 spawners per year is needed to minimize potential inbreeding effects within local populations. In addition, a population size of between 500 and 1,000 adults in a core area is needed to minimize the deleterious effects of genetic variation from drift.

For the purposes of bull trout recovery planning, abundance levels were conservatively evaluated at the local population and core area levels. Local populations containing fewer than 100 spawning adults per year were classified as at risk from inbreeding depression. Bull trout core areas containing fewer than 1,000 spawning adults per year were classified as at risk from genetic drift.

Bull trout in the Lower Columbia Recovery Unit persist at low numbers in fragmented local populations. Adult population estimates for bull trout in Swift Creek Reservoir (Pine and Rush creeks combined) ranged from 101 to 542 from 1994 to 2001, respectively. The majority of spawning occurs in Rush Creek and the 8 year average for both creeks is 309 bull trout. Based on the aforementioned guidance, bull trout in Rush and Pine creeks are not at risk from inbreeding depression. Conversely, the local population in Cougar Creek is significantly below 100 individuals and is considered at risk. Overall, the Lewis Core Area is probably below 1,000 spawning adults annually and should be considered at risk from the deleterious effects of genetic drift. Bull trout in the West Fork Klickitat local population are thought to be primarily resident and low numbers indicate that this local population is at risk from inbreeding depression. If fluvial bull trout persist in the Klickitat Core Area, their abundance is most likely below 100 spawning adults, and therefore should be considered at risk from inbreeding depression. The interaction of any fluvial forms with the observed resident local population in the West Fork Klickitat is considered a

research need. Abundance of both resident and migratory bull trout in the Klickitat Core Area is likely below 1,000 spawning individuals and the core area is considered at risk from genetic drift.

Estimated abundance of bull trout among all local populations under a recovered condition in the Lower Columbia Recovery Unit is considered a research need. Uncertainty surrounding the number of local populations under a recovered condition in each core area precluded determination of the recovered abundance estimate in the Lower Columbia Recovery Unit. As more data is collected, recovered population estimates will be identified to more accurately reflect both the migratory, and resident life history components. In determining the recovered abundance, consideration of genetic risk, effective population size, and connectivity need to be incorporated with habitat productivity estimates in order to determine achievable abundance goals.

Productivity

A stable or increasing population is a key criterion for recovery under the requirements of the Endangered Species Act. Measures of the trend of a population (the tendency to increase, decrease, or remain stable) include population growth rate or productivity. Estimates of population growth rate (*i.e.*, productivity over the entire life cycle) that indicate a population is consistently failing to replace itself also indicate an increased risk of extinction. Therefore, the reproductive rate should indicate that the population is replacing itself, or growing.

Since estimates of the total population size are rarely available, the productivity or population growth rate is usually estimated from temporal trends in indices of abundance at a particular life stage. For example, redd counts are often used as an index of a spawning adult population. The direction and magnitude of a trend in the index can be used as a surrogate for the growth rate of the entire population. For instance, a downward trend in an abundance indicator may signal the need for increased protection, regardless of the actual size of the population. A population that is below recovered abundance levels, but that is moving toward recovery, would be expected to exhibit an increasing trend in the indicator.

The population growth rate is an indicator of probability of extinction. This probability cannot be measured directly, but it can be estimated as the consequence of the population growth rate and the variability in that rate. For a population to be considered viable, its natural productivity should be sufficient for the population to replace itself from generation to generation. Evaluations of population status will also have to take into account uncertainty in estimates of population growth rate or productivity. For a population to contribute to recovery, its growth rate must indicate that the population is stable or increasing for a period of time. Given the overall lack of long-term population census information in the Lewis and Klickitat core areas, and the variability in abundance estimates for the Cougar Creek local population, bull trout in the Lower Columbia Recovery Unit were classified at increased risk.

Connectivity

The presence of the migratory life history form within the Lower Columbia Recovery Unit was used as an indicator of the functional connectivity of the system. If the migratory life form was absent from the core area, or if the migratory form is present but local populations lack connectivity, the core area was considered to be at increased risk. If the migratory life form persists in at least some local populations, with partial ability to connect with other local populations, the core area was judged to be at intermediate risk. Finally, if the migratory life form was present in all or nearly all local populations, and had the ability to connect with other local populations, the core area was considered to be at diminished risk.

Lack of passage at hydroelectric facilities within the Lower Columbia Recovery Unit has fragmented bull trout populations and prevented migration to foraging and overwintering habitat in the mainstem Columbia River. Migratory bull trout persist at low numbers within the Lower Columbia Recovery Unit by virtue of adopting an adfluvial life history in Swift Creek Reservoir and Yale Lake. Lack of passage and the low abundance of the migratory life history strategy also limits the possibility for genetic exchange and local population refounding.

Even though the migratory form persists in the Lewis River, the Lower Columbia Recovery Unit Team considered bull trout in the core area to be at an increased risk since local populations lack connectivity. Currently, bull trout in the Klickitat Core Area are most likely represented by resident forms, and consequently are also at an increased risk.

Recovery Criteria

Recovery criteria for bull trout in the Lower Columbia Recovery Unit are as follows.

1. **The recovered distribution of bull trout in the Lower Columbia Recovery Unit is unknown and considered a research need. Until additional information is obtained, at a minimum, the four existing local populations in the recovery unit need to be maintained.** Current local populations are Rush and Pine creeks (Swift Creek Reservoir) and Cougar Creek (Yale Lake) both in the Lewis Core Area, and the West Fork Klickitat River in the Klickitat Core Area. These local populations need to be maintained while studies are initiated to identify additional local populations. The establishment of additional local populations in the Lewis Core Area is essential for recovery to spread the risk of population decline or local population extirpation due to stochastic events.

   Potential local populations in the Lewis (*e.g.*, Speelyai, Rain, Ole creeks, Swift by-pass reach, and upper mainstem Lewis River) have already been identified and research should be directed at factors limiting reintroduction. While the White Salmon River is recognized as historic core habitat, and necessary for recovery, specific tributaries where local populations could occur is unknown. Similarly, additional spawning and rearing areas within the Klickitat River have not been identified. Studies in the White Salmon and Klickitat rivers should assess the potential habitat suitability and productive capacity of tributaries that could support local populations. Subsequently, factors that may limit the reintroduction potential should be identified, and corrective restoration activities or management actions should be

implemented. Reestablishment of local populations within the White Salmon and Klickitat rivers may require the use of artificial propagation which would follow current Federal policy (65 FR 56916). The Lower Columbia Recovery Team recommends that studies be initiated to determine the effectiveness and feasibility of using fish transfers and hatcheries to assist in any future reintroduction efforts. Potential local populations should be identified within 3 years and actions needed to implement reintroduction efforts will be incorporated in the review of the Lower Columbia River Recovery Unit plan.

2. **Estimated abundance of bull trout among all local populations under a recovered condition in the Lower Columbia Recovery Unit is considered a research need.** Uncertainty surrounding the number of local populations under a recovered condition in each core area precluded determination of the recovered abundance estimate in the Lower Columbia Recovery Unit. As more data is collected, recovered population estimates will be identified to more accurately reflect both the migratory, and resident life history components. In determining the recovered abundance, consideration of genetic risk, effective population size, and connectivity need to be incorporated with habitat productivity estimates in order to determine achievable abundance goals.

3. **Adult bull trout exhibit a stable or increasing trend for at least 2 generations at or above the recovered abundance level within core areas.** The development of a standardized monitoring and evaluation program which would accurately describe trends in bull trout abundance is identified as a priority research need. As part of the overall recovery effort, the U.S. Fish and Wildlife Service will take the lead in addressing this research need by forming a multi-agency technical team to develop protocols to evaluate trends in bull trout populations.

4. **Specific barriers to bull trout migration in the Lower Columbia Recovery Unit have been addressed.** The barriers that are identified as primary impediments to recovery and where connectivity must be reestablished are at Swift Dam (Number 1 and 2) and Yale Dam both on the Lewis River; and

Condit Dam on the White Salmon River. Identification of these barriers does not imply that other actions associated with passage (*e.g.*, culverts), habitat degradation, or nonnative species control are not crucial for recovery to occur.

Recovery criteria for the Lower Columbia Recovery Unit were established to assess whether recovery actions have resulted in the recovery of bull trout. The Lower Columbia Recovery Unit Team expects that the recovery process will be dynamic and require refinements as more information becomes available over time. The Lower Columbia Recovery Unit Team expects that the recovery process will be dynamic and will be refined as more information becomes available. While removal of bull trout as a species under the Endangered Species Act (*i.e.*, delisting) can only occur for the entity that was listed (Columbia River Distinct Population Segment), the recovery unit criteria listed above will be used to determine when the Lower Columbia Recovery Unit is fully contributing to recovery of the population segment.

Research Needs

Based on the best scientific information available, the Lower Columbia Recovery Unit Team has identified recovery criteria, and actions necessary for recovery of bull trout within the recovery unit. However, the recovery unit team recognizes that uncertainties exist regarding bull trout population abundance, distribution, and actions needed. The recovery team feels that if effective management and recovery are to occur, the recovery plan for the Lower Columbia Recovery Unit should be viewed as a "living" document and will incorporate new information, research findings, and recovery accomplishments. As part of this adaptive management approach, the recovery unit team has identified research needs which are essential within the recovery unit.

Bull Trout Distribution and Abundance

A key information gap and research need is to define the recovered distribution within the Lewis, White Salmon, and Klickitat rivers. A complete habitat suitability inventory needs to be conducted in order to determine if these areas meet

habitat requirements for bull trout. Within the Lewis, Speelyai, Rain, Ole creeks, and the upper mainstem Lewis River should be evaluated for their potential to support bull trout local populations.

Similarly, tributaries have been identified within the Klickitat system which provide basic cold water habitat conditions necessary for bull trout (WDFW 2000a). These streams include: Bird Creek, Hellroaring Creek, Big Muddy Creek, West Fork Klickitat River (Little Muddy Creek and Fish Lake Stream), Trappers Creek, Clearwater Creek, Crawford Creek, McCreedy Creek, Piscoe Creek, and Diamond Fork Creek. In addition, increased survey work is needed in the Cowlitz and Kalama rivers in order to determine if bull trout are present in these systems.

Historically, bull trout may have inhabited areas within the Cowlitz and Kalama rivers, but current distribution within the basin is unknown (WSCC 2000a; 2000b). The Cowlitz and Kalama rivers are considered research needs and additional information is required to determine if each respective system is important for bull trout recovery.

To assist in the identification of additional bull trout local populations, guidelines for evaluating habitat elements necessary for bull trout need to be updated, or in some cases developed. These guidelines should include recommendations on appropriate conditions associated with sediment delivery,
water temperature, physical habitat requirements (*e.g.*, large woody debris), instream flow, and normative hydrologic function.

After identification of additional local populations, studies to identify the habitat the productive capacity of each potential local population should be initiated. Comparisons of nearby bull trout watersheds (*e.g.*, Hood River) could be useful in evaluating the productive capabilities of potential local populations and core areas (*e.g.*, White Salmon River). In determining the recovered abundance, consideration of genetic risk, effective population size, and connectivity need to be incorporated with habitat productivity estimates in order to determine achievable abundance goals.

Columbia River

A primary research need is a more thorough understanding of the current, and future, role that the mainstem Columbia should play in the recovery of bull trout. Five adult bull trout have recently (1994 to 1998) been caught in the northern pikeminnow fishery conducted by the Washington Department of Fish and Wildlife in Bonneville Pool and the mainstem Columbia River below Bonneville Dam (Wachtel *in litt.* 2000). Older records have documented bull trout or Dolly Varden at Bonneville Dam and in the lower Columbia River near Jones Beach (Bonneville Fishway Report *in litt.* 1947; Catch Card Records *in litt.* 1966 to 1981). Historic records also indicate that bull trout used the lower mainstem Columbia River. Dolly Varden (bull trout) were caught in fishwheels operated on the mainstem Columbia in the late 1800's (Donaldson and Cramer 1971).

It seems likely that fluvial bull trout in the Lower Columbia Recovery Unit historically migrated to the mainstem Columbia River to overwinter and feed. Given that bull trout have been found in Drano Lake, below Condit Dam (most likely Hood River origin), and at the mouth of the Klickitat, similar use of the mainstem Columbia by adult bull trout from either the Lewis or White Salmon rivers might be expected if barriers were removed (WDFW 1998; Wachtel *in litt.* 2000).

Bull trout in other Columbia River tributaries (*e.g.*, Hood and Wenatchee rivers) are known to migrate downstream to the mainstem Columbia River as part of their normal life history strategies (ODFW 1997; Kelly-Ringel and De La Vergne 2001; Kreiter 2001). Uncertainty in the current use of the mainstem Columbia River by fluvial bull trout within the recovery unit has led the recovery team to identify the Columbia River as potential core habitat and as a primary research need. A better understanding of migration patterns between basins would greatly enhance the opportunities for recovery. The recovery team believes that migrational studies should be coordinated with the Hood River Unit in order to provide a more complete understanding of adult bull trout habitat requirements.

Monitoring and Evaluation

The Lower Columbia Recovery Unit Team realizes that recovery criteria will most likely be revised as recovery actions are implemented and bull trout populations begin to respond. In addition, the Lower Columbia Recovery Unit Team will rely on adaptive management to better refine both abundance and distribution criteria. Adaptive management is a continuing process of planning, monitoring, evaluating management actions, and research. This approach will involve a broad spectrum of user groups and will lay the framework for decision making relative to recovery implementation and ultimately, the possible revision of recovery criteria in this recovery unit.

This recovery unit chapter is the first step in the planning process for bull trout recovery in the Lower Columbia Recovery Unit. Monitoring and evaluation of population levels and distribution will be an important component of any adaptive management approach. The U.S. Fish and Wildlife Service will take the lead in developing a comprehensive monitoring approach which will provide guidance and consistency in evaluating bull trout populations. Development and application of models which assess extinction risk relative to abundance and distribution parameters are critical in refining recovery criteria as the recovery process proceeds. Application of agreed upon methods for evaluating recovery would benefit the scientific community and user groups alike.

Artificial Propagation

The Lower Columbia Recovery Unit Team has identified that reestablishment of local populations within the White Salmon and Klickitat rivers within 25 years may require the use of artificial propagation. Abundance in both the Klickitat and White Salmon rivers are extremely low, and natural recolonization may not occur within recovery time frames. Artificial propagation could involve the transfer of bull trout into unoccupied habitat within the historic range (ODFW 1997). In addition, artificial propagation could involve the use of Federal or State hatcheries to assist in recovery efforts (MBTSG 1996c). The Lower Columbia Recovery Team

recommends that studies be initiated to determine the effectiveness and feasibility of using artificial propagation in bull trout recovery.

Any artificial propagation program instituted in the Lower Columbia Recovery Unit must follow the joint policy of the Fish and Wildlife Service and the National Marine Fisheries Service regarding controlled propagation of listed species (65 FR 56916). The overall guidance of the policy is that every effort should be made to recover a species in the wild before implementing a controlled propagation program. If necessary, an appropriate plan would need to be approved that considers the effects of transplantation on other species as well as the donor bull trout populations. Transplanting listed species must be authorized by the U.S. Fish and Wildlife Service and meet applicable State fish-handling and disease policies.

While artificial propagation has played an important role in the recovery of other listed fish species, where possible, the overall recovery strategy for bull trout in the Lower Columbia Recovery Unit will emphasize the removal of threats and habitat restoration. Recovery should emphasize identifying and correcting threats affecting bull trout and bull trout habitats. Artificial propagation programs should not be implemented unless reasons for decline have been addressed.

Genetic Studies

The Lower Columbia Recovery Unit Team recommends that studies be initiated to describe the genetic makeup of bull trout in the mainstem Columbia and Klickitat rivers. Genetic information for the Lewis Core Area has already been collected and analyzed (Spruell *et al.* 1998), and additional information from the Columbia and Klickitat rivers is necessary for a more complete understanding of bull trout interactions and population dynamics. In addition, a recovery unit wide evaluation of the current and potential threat of bull trout hybridization with brook trout is needed. The ability to evaluate the potential harm to specific local populations could be used in prioritizing management actions. Genetic baseline information would also be a necessity in the implementation of any artificial propagation program.

ACTIONS NEEDED

Recovery Measures Narrative

In this chapter and all other chapters of the bull trout recovery plan, the recovery measures narrative consists of a hierarchical listing of actions that follows a standard template. The first-tier entries are identical in all chapters and represent general recovery tasks under which specific (*e.g.*, third-tier) tasks appear when appropriate. Second-tier entries also represent general recovery tasks under which specific tasks appear. Second-tier tasks that do not include specific third-tier actions are usually programmatic activities that are applicable across the species' range; they appear in *italic type*. These tasks may or may not have third-tier tasks associated with them; see Chapter 1 for more explanation. Some second-tier tasks may not be sufficiently developed to apply to the recovery unit at this time; they appear in *a shaded italic type (as seen here)*. These tasks are included to preserve consistency in numbering tasks among recovery unit chapters and intended to assist in generating information during the comment period for the draft recovery plan, a period when additional tasks may be developed. Third-tier entries are tasks specific to the Lower Columbia Recovery Unit. They appear in the implementation schedule that follows this section and are identified by three numerals separated by periods.

The Lower Columbia Recovery Unit should be updated or revised as recovery tasks are accomplished, or revised as environmental conditions change, and monitoring results or additional information become available. Revisions to the Lower Columbia Recovery Unit chapter will likely focus on priority streams or stream segments within core areas where restoration activities occurred, and habitat or bull trout populations have shown a positive response. The Lower Columbia Recovery Unit Team should meet annually to review annual monitoring reports and summaries, and make recommendations to the U.S Fish and Wildlife Service.

1 Protect, restore, and maintain suitable habitat conditions for bull trout.

1.1 Maintain or improve water quality in bull trout core areas or potential core habitat.

1.1.1 **Conduct limiting factors analysis for water quality problems in the upper Klickitat River.** In cooperation with the Yakama Nation, conduct limiting factors analysis on Reservations Lands in the upper Klickitat River. This analysis should evaluate the impacts of roads, agricultural practices, and timber management on water quality in current or potential bull trout habitat. After study completion, prioritize areas for restoration activities.

1.1.2 **Improve water quality.** Implement restoration activities in Rush, Pine, and Cougar creeks to reduce sediment load, stabilize banks, and normalize peak flow events.

1.2 Identify barriers or sites of entrainment for bull trout and implement tasks to provide passage and eliminate entrainment.

1.2.1 **Provide fish passage at Swift and Yale dams.** Evaluate passage options and implement actions necessary to restore two way passage at Swift (Number 1 and 2), Yale, and Merwin dams through the relicensing process. Passage at Swift (Number 1 and 2) and Yale dams is necessary to reconnect Cougar, Rush, and Pine creeks local populations. Reconnecting these populations is a Priority 1 action, and would allow for bull trout movement between reservoirs and would strengthen spawning populations in Cougar Creek.

1.2.2 **Provide fish passage at Condit Dam.** Coordinate with ongoing efforts to provide passage at Condit Dam on the White Salmon River. As part of the relicensing process PacifiCorp is considering removing the facility. Passage at Condit Dam is essential for reestablishing fluvial bull trout in the White Salmon River.

1.2.3 **Evaluate passage options of bull trout at Speelyai hatchery diversion.** Passage at the hatchery diversion would assist in

establishing an additional local population of bull trout in the Lewis River Core Area. Implement actions to provide passage if feasible.

1.2.4 **Reduce entrainment.** Quantify the level of entrainment at Yale Dam and Swift Dam (Number 1 and 2) and recommend actions to reduce impacts.

1.2.5 **Conduct limiting factors analysis for culvert problems.** Survey all culverts intersecting fish-bearing streams in the Lower Columbia Recovery Unit. Based on identification of additional local populations, implement programs to correct barrier problems. Surveys should include assessment of available habitat quantity and quality above the culvert to aid in prioritization of barrier correction.

1.2.6 **Conduct limiting factors analysis for instream flow problems.** Identify current and potential bull trout streams with instream flow problems and implement corrective actions (*e.g.*, Swift bypass reach) where feasible.

1.2.7 **Provide fish passage at Merwin Dam.** Partial passage currently exists at Merwin Dam and implementing actions to improve passage would allow bull trout access to the mainstem Columbia River for overwintering and feeding.

1.3 Identify impaired stream channel and riparian areas and implement tasks to restore their appropriate functions.

1.3.1 **Maintain current conservation practices on lower Rush Creek.** Rush Creek is the most important spawning area in the Lower Columbia Recovery Unit and maintaining quality habitat is essential for recovery.

1.3.2 **Protect and restore habitat in upper Rush and Pine creeks.** Implement habitat restoration activities in Rush and Pine watersheds to address problems with shading, slope stability, channel complexity and riparian revegetation.

1.3.3 **Collaborate with the Yakama Nation.** Work with Yakama Nation to assess habitat conditions and recommend restoration actions on reservation lands in the upper Klickitat watershed.

1.3.4 **Work with private landholders.** Work with private landholders (A and E Forest of Lewis River and Olympic Resources Group) to assess habitat conditions and recommend restoration actions where appropriate within Pine Creek drainage.

1.3.5 **Conduct limiting factors analysis for floodplain connectivity.** Conduct bull trout specific evaluation of limiting factors associated with floodplain connectivity and riparian condition in the Lewis and Klickitat core areas, the White Salmon core habitat, and the Cowlitz/Kalama watershed. Implement corrective actions where appropriate.

1.3.6 **Conduct limiting factors analysis for impact of roads.** Identify roads that are susceptible to mass wasting and bank failures, intercept surface or ground water, negatively impact riparian areas, and inhibit connectivity and natural stream function in the Lewis and Klickitat core areas, the White Salmon core habitat, and the Cowlitz/Kalama watershed. Implement corrective actions where appropriate.

1.4 Operate dams to minimize negative effects on bull trout in reservoirs and downstream.

1.5 Identify upland conditions negatively affecting bull trout habitats and implement tasks to restore appropriate functions.

2 Prevent and reduce negative effects of nonnative fishes and other nonnative taxa on bull trout.

2.1 Develop, implement, and enforce public and private fish stocking policies to reduce stocking of nonnative fishes that affect bull trout.

2.2 Enforce policies for preventing illegal transport and introduction of nonnative fishes.

2.3 Provide information to the public about ecosystem concerns of illegal introductions of nonnative fishes.

2.4 Evaluate biological, economic, and social effects of control of nonnative fishes.

2.5 *Implement control of nonnative fishes where found to be feasible and appropriate.*

2.6 *Develop tasks to reduce negative effects of nonnative taxa on bull trout.*

3 Establish fisheries management goals and objectives compatible with bull trout recovery, and implement practices to achieve goals.

3.1 Develop and implement State and Ttribal native fish management plans integrating adaptive research.

3.1.1 **Develop bull trout management plan.** Develop specific bull trout fishery management plan for core areas in the Lower Columbia Recovery Unit.

3.1.2 **Conduct assessment of nutrient levels and cycling**. Passage barriers on the Lewis and White Salmon rivers prevent anadromous salmon and steelhead from volitionally entering these systems and may have negatively impacted nutrient levels and natural cycling.

3.2 Evaluate and prevent overharvest and incidental angling mortality of bull trout.

3.2.1 **Provide information to anglers.** Provide information to anglers about bull trout identification, special regulations, fisheries management of endangered species, and how to reduce hooking mortality of bull trout caught incidentally in recreational fisheries.

3.2.2 **Investigate and minimize incidental or illegal catch of bull trout.** Investigate and minimize incidental catch of bull trout by increasing enforcement in the Lewis (*e.g.*, below Eagle Cliff Bridge) and Klickitat rivers; below Condit Dam on the White Salmon River; and the Bonneville Pool sport fishery specifically at Drano Lake. Increasing information signs at Drano Lake and the Klickitat River. Increase outreach activities, informational signs, and regulation changes when necessary.

3.2.3 **Address road access impacts.** Identify roads that may facilitate poaching for bull trout in the Lewis River above Swift Creek Reservoir and restrict access where appropriate.

3.2.4 **Evaluate impacts of fishing regulations.** Evaluate, and recommend changes if necessary, for current fishing regulations on bull trout in the area below Eagle Cliff Bridge to prevent incidental and illegal harvest.

3.3 Evaluate potential effects of introduced fishes and associated sport fisheries on bull trout recovery and implement tasks to minimize negative effects on bull trout.

3.3.1 **Assess impact of nonnative species.** Assess impact of nonnative species (*e.g.*, brook trout) on bull trout within core areas of the Lower Columbia Recovery Unit and develop priorities, strategies and cost estimates for control.

3.3.2 **Reduce and/or control nonnative species.** Based on 3.3.1, where appropriate institute measures to control and reduce nonnative species numbers and interactions with bull trout.

3.3.3 **Investigate ecological interactions.** Investigate ecological interactions among bull trout, northern pikeminnow, and tiger musky in Lake Merwin, and interactions between bull trout and hatchery salmon below Condit Dam.

3.4 *Evaluate effects of existing and proposed sport fishing regulations on bull trout.*

4 Characterize, conserve, and monitor genetic diversity and gene flow among local populations of bull trout.

4.1 Incorporate conservation of genetic and phenotypic attributes of bull trout into recovery and management plans.

4.2 Maintain existing opportunities for gene flow among bull trout populations.

4.3 Develop genetic management plans and guidelines for appropriate use of transplantation and artificial propagation.

4.3.1 **Develop and establish genetic protocols.** Establish genetic reserve protocols and standards for initiating, conducting, and evaluating artificial propagation programs for bull trout.

4.3.2 **Establish genetic baselines.** Genetic baseline descriptions of bull trout in the Columbia and Klickitat rivers are essential for a complete understanding of bull trout interactions and population dynamics.

4.3.3 **Evaluate hybridization with brook trout.** Recovery unit-wide evaluation of the current and potential threat of bull trout hybridization with brook trout is needed. The ability to evaluate the potential harm to specific local populations can be used in prioritizing management actions.

4.3.4 **Conduct feasibility study on artificial propagation in the White Salmon and Klickitat basins.** Reestablishment of local populations within the White Salmon and Klickitat rivers may require the use of artificial propagation. The Lower Columbia Recovery Team recommends that studies be initiated to determine the effectiveness and feasibility of using fish transfers and hatcheries to assist in any future reintroduction efforts.

4.3.5 **Conduct artificial propagation where deemed necessary and appropriate (using results from task 4.3.4).**

5 Conduct research and monitoring to implement and evaluate bull trout recovery activities, consistent with an adaptive management approach using feedback from implemented, site-specific recovery tasks.

5.1 *Design and implement a standardized monitoring program to assess the effectiveness of recovery efforts affecting bull trout and their habitats.*

5.2 Conduct research evaluating relationships among bull trout distribution and abundance, bull trout habitat, and recovery tasks.

5.2.1 **Standardize and implement sampling protocol for bull trout, particularly in the Lewis, White Salmon, and Klickitat basins.** Support ongoing efforts through the American Fisheries Society to develop methods and protocols for detection of bull trout. Additional data is needed to refine and clarify the recovered distribution of bull trout in the Lower Columbia Recovery Unit.

5.2.2 **Develop and implement habitat guidelines.** Develop and implement guidelines for bull trout that restore or maintain habitat elements (*e.g.*, sediment delivery, water temperature, normative hydrologic function) to provide for recovery. These guidelines will be used to help identify areas within the White Salmon and Klickitat rivers which could support local populations of bull trout.

5.3 Conduct evaluations of the adequacy and effectiveness of current and past Best Management Practices in maintaining or achieving habitat conditions conducive to bull trout recovery.

5.4 *Evaluate effects of diseases and parasites on bull trout, and develop and implement strategies to minimize negative effects.*

5.5 Develop and conduct research and monitoring studies to improve information concerning the distribution and status of bull trout.

5.5.1 **Conduct fish surveys.** Expanded fish surveys are needed in the Cowlitz and Kalama rivers to determine if bull trout are present.

5.5.2 **Identify potential local populations**. Investigate temperature profile, flow regime, and habitat characteristics of Lewis tributaries (Speelyai, Rain, Ole creeks), White Salmon River tributaries, and Klickitat River tributaries (*e.g.*, Diamond Fork) for the potential to establish local populations. Identification of potential tributaries which could support local populations is necessary in order to refine the recovered distribution of bull trout and is considered a priority 1 action. Use guidance from task 1.3.5.

5.6 Identify evaluations needed to improve understanding of relationships among genetic characteristics, phenotypic traits, and local populations of bull trout.

6 Use all available conservation programs and regulations to protect and conserve bull trout and bull trout habitats.

6.1 Use partnerships and collaborative processes to protect, maintain, and restore functioning core areas for bull trout.

6.1.1 **Support collaborative efforts by local watershed groups**. Support collaborative efforts by local watershed groups to improve water quality and accomplish site specific habitat protection and restoration activities in the Lewis and Klickitat core areas. Similar actions should be conducted in the White Salmon River. Provide incentives and support development of Habitat Conservation Plans and Safe Harbor Agreements.

6.1.2 **Protect habitat.** Provide long-term habitat protection through purchase from willing sellers, land exchange, conservation easements, managements, with initial emphasis on identified bull trout spawning and rearing streams. Emphasis should be placed on areas within the Klickitat and White Salmon rivers.

Coordinate with local governments and watershed councils to identify opportunities.

6.1.3 **Coordinate recovery efforts**. Coordinate bull trout recovery activities with Federal, State, and Tribal anadromous fish reintroductions and recovery plans.

6.2 Use existing Federal authorities to conserve and restore bull trout.

6.2.1 **Participate in relicensing activities.** Complete relicensing of Swift, Yale, Merwin, and Condit dams and implement appropriate mitigation activities.

6.3 Enforce existing Federal and State habitat protection standards and regulations and evaluate their effectiveness for bull trout conservation.

6.3.1 **Continue management of U.S. Forest Service lands under Northwest Forest Plan and INFISH.** Continue restoration activities in key and priority watersheds, development of watershed analyze, and support long-term monitoring to ensure conservation of bull trout.

6.3.2 **Coordinate with State bull trout management plans.** Incorporate bull trout recovery actions into updated Washington State bull trout management plans to ensure consistency.

7 Assess the implementation of bull trout recovery by recovery units, and revise recovery unit plans based on evaluations.

7.1 Convene annual meetings of each recovery unit team to generate progress reports on implementation of the recovery plan for the U.S. Fish and Wildlife Service.

7.2 Develop and implement a standardized monitoring program to evaluate the effectiveness of recovery efforts (coordinate with 5.1).

7.3 Revise scope of recovery as suggested by new information.

7.3.1 **Periodically review progress toward recovery goals and assess recovery task priorities.** Annually review progress toward population and adult abundance criteria and recommend changes, as needed, to the Lower Columbia Recovery Unit Chapter. In addition, review tasks, task priorities, completed tasks, budget, time-frames, particular successes, and feasibility within the Lower Columbia Recovery Unit. Updates must include identification of additional local populations in the Lewis, Klickitat, and White Salmon rivers and feasibility analysis on use of Federal and State hatcheries in artificial propagation for reintroduction efforts in the Lower Columbia Recovery Unit.